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Illumination Method, Illumination System and the Components Thereof, Especially for Illuminating Hollow Bodies such as Signs, Inscriptions, Letters, Especially Relief Letters and the Like as well as a Sign, An Inscription and a Letter, Especially Relief Letter with Illumination

The invention relates to a lighting method, lighting system and its components, in particular for illuminating hollow elements such as signs, inscriptions, letters, in particular relief letters and the like, and a sign, inscription, letter, in particular a relief letter with illumination means.

When hollow elements such as signs, inscriptions, letters and in particular relief letters such as are used, for example, in outdoor advertising are illuminated, there is the problem of illuminating the respective hollow element, that is to say a relief letter for example, in a uniform way. Such relief letters are usually made up of a housing for accommodating lighting means such as tubular lamps and a translucent, usually colored housing cover in the form of the letter. It is to be noted here that the term "relief letter" is to be understood as referring to all types of internally illuminated, three-dimensional letters, numerals, characters and logos, that is to say not only to the 26 letters of the Latin alphabet.

In particular in the case of relief letters, uniform illumination is not a minor technical lighting problem if the letters are to be easily readable even from a distance. If the illumination is not uniform, it is possible, for

example, for a G to look like a C or a 6 and for an 8 to look like an S.

In order to overcome the technical lighting problems of the mentioned type, use has been made for a long time, in particular in outdoor advertising, of tubular lamps, often referred to as "neon lamps", whose lighting elements are adapted to the shape of the hollow element to be illuminated by skilled glassblowers. Specific fabrication of tubular lamps with a shape which is adapted to the hollow element to be illuminated is, however, complicated and expensive. In addition, a tubular lamp which is fabricated for a specific letter, for example an R with a height of 400 mm can only be used in an R of the same design.

As an alternative to tubular lamps, in the last few years use has been increasingly made of what is referred to as LED tubes in which a large number of LEDs are arranged in a transparent flexible tube. LED technology has a range of considerable advantages over tubular lamps in this respect, for example significantly longer service life and significantly low power consumption. However, the attachment of the LED tubes in the hollow element which is to be respectively illuminated presents a problem. In the case of relief letters, the tubes are usually bonded to an inner wall of the housing using heat-set adhesive, and can therefore not be readily recycled.

The length of the LED tubes cannot be easily adapted to the required dimension, and illuminating bars which cross, for example in the case of an X or branching as in the case of

Sub a2

a Y presents further problems if the illumination is to be uniform. Although LED technology has a range of fundamental advantages over tubular lamps, for this reason LED tubes have not been able to gain acceptance in practice particularly with letters.

Taking the above as a starting off point, the invention is based on the object of specifying a lighting method and a lighting system which permit the advantages of LED technology to be used even when solving complicated illumination problems, such as the illumination of relief letters.

The object is achieved on the one hand by a system according to Claim 1. The system has a range of considerable advantages: it can be retrofitted, can be used universally, requires only a few different components, does not require any high voltage and is easy to mount.

As a result of the use of the technology according to the invention, it is also possible to replace the tubular lamps in already existing inscriptions and letters. In this way the power consumption can be reduced by 90%.

The service life of the LEDs is up to 100,000 hours.
They are fully recyclable and are manufactured in an environmentally friendly way.

Further advantages are:
Less hazardous handling during maintenance and mounting procedures as a result of 12 Volt technology (neon tubes = high voltage 6000 Volts and higher). => Different

classification of mounting operations by employer's liability insurance associations

- No risk of fire
- Constant brightness over the entire service life (there is a loss of brightness after just one year with neon)
- Constant brightness even in extreme cold (with neon there is a loss of brightness at 5°C and below).

The lighting system can be operated with batteries or accumulators. In another advantageous development, at least one transformer is provided for transforming a mains voltage to an operating voltage of the LEDs.

In one advantageous embodiment of the lighting system for lighting a surface, in particular the translucent surface of a relief letter, the LEDs being arranged on, in each case, one flat side of a printed circuit board, there is provision for the surface of the flat sides, fitted with the LEDs, of each printed circuit board to be significantly smaller than the surface to be illuminated.

In order to cover as many application cases as possible, printed circuit boards of different sizes can advantageously be provided.

In principle, each printed circuit board can be provided with its own power supply. However, it is advantageous to embody the printed circuit boards in such a way that each printed circuit board has at least two connecting points, each with a positive lead and a negative lead for current, to which the cables can be connected by means of a

standardized plug. In this way, a plurality of printed circuit boards can be connected in series.

The connecting points and the plugs can advantageously be embodied in such a way that a plug which is connected to a connecting point protects the positive and negative leads against moisture.

For use externally, for example when illuminating relief letters, a transformer which is protected against moisture can advantageously be used.

In a further advantageous development, a regulating module can be provided for regulating the power supply to individual printed circuit boards and/or individual LEDs on the printed circuit boards in a selective fashion so that different illumination effects can be set.

The printed circuit board is particularly suitable for illuminating letters and the like if the LEDs have an irradiation angle of more than 150°, preferably 175° to 180°. In this way, even very flat letters can be illuminated uniformly.

It is possible to use customary LEDs. However, it has proven particularly advantageous if LEDs which are mounted on the printed circuit board using what is referred to as the chip-on-board method, also referred to as LED chips, are used.

In order to homogenize the irradiation and simultaneously protect the LED, each LED can be provided with a translucent lens-like coating.

LEDs with a power between approximately 0.04 and 0.12 Watts have proven particularly expedient in the illumination of letters. The printed circuit board advantageously has at least one protective resistor for protecting the LEDs.

A printed circuit board in which a number of LEDs, preferably 2 to 4 LEDs, are connected in series with one protective resistor in each case on each printed circuit board has proven to be the best embodiment in terms of the lighting behavior in case of failures relative to the manufacturing costs.

All the LEDs can advantageously be arranged on one flat side of the printed circuit board and none of the components protruding from the flat side can be arranged on the flat side on which the LEDs are arranged.

It is expedient if the flat side on which the LEDs are arranged is constructed so as to reflect light, and is in particular white or mirror-coated so that the light yield can be utilized particularly satisfactorily.

Particularly when in use externally it is advantageous to equip each of the printed circuit boards in a weather-resistant fashion, in particular with a coating which protects the conductor tracks and the LEDs against moisture.

The printed circuit boards can also be constructed in such a way that all the LEDs provided on the printed circuit board irradiate light of the same color, specifically preferably of a color which is adapted to the color of the cover of the letter (green letter - green LEDs).

However, it is also possible to produce any desired color combinations if LEDs are arranged on the printed circuit board in each case in groups of three located close to one another, a group of three being made up of LEDs with three different colors which are suitable for additive color mixing.

For use for illuminating relief letters, the best embodiment has proven to be a system in which three different printed circuit boards are provided, specifically:

a printed circuit board on which three LEDs are arranged in a straight line, the distance between two adjacent LEDs being approximately 14 to 20 mm and the printed circuit board being approximately 50 to 60 mm long, approximately 8 to 16 mm wide and approximately 1 to 3 mm thick.

a printed circuit board on which six LEDs are arranged in a straight line, the distance between two adjacent LEDs being approximately 14 to 20 mm and the printed circuit board being approximately 90 to 120 mm long, approximately 8 to 16 mm wide and approximately 1 to 3 mm thick.

a printed circuit board on which nine LEDs are arranged offset from one another in a zigzag shape on two straight

lines, the distance between the two lines being approximately 25 to 35 mm and the distance between two adjacent LEDs arranged on a line being approximately 30 to 40 mm.

26. Printed circuit board according to Claim 25, characterized in that the printed circuit board is approximately 140 to 160 mm long, approximately 32 to 42 mm wide and approximately 1 to 3 mm thick.

27. Printed circuit board according to one of Claims 10 to 27, characterized in that an opening for an attachment element for attaching the printed circuit board is provided.

28. Printed circuit board according to one of Claims 10 to 27, characterized in that at least two connecting points each with a positive lead and a negative lead for current are provided, each connecting point being designed for the connection of standardized plugs.

29. Printed circuit board according to Claim 28, characterized in that a guide groove for guiding a plug is provided in the vicinity of each connecting point.

30. Printed circuit board according to Claim 28 or 29, characterized in that a corresponding element which is at least partially complementary to a latching element of a plug, in particular a mounting opening, is provided in the vicinity of each connecting point.

31. Plug for a system according to one of Claims 1 to 10, characterized in that the plug is designed in such a way that a plug which is connected to a connecting point of a printed circuit board protects the positive and negative leads against moisture.

32. Plug for a system according to one of Claims 1 to 10, characterized in that the plug has a latching element which, after the plug has been fitted onto a printed circuit board, latches with a corresponding element provided for that purpose on the printed circuit boards.

33. Attachment element for a system according to one of Claims 1 to 10, characterized in that a self-adhesive film is provided on one flat side of the attachment element.

34. Attachment element for a system according to one of Claims 1 to 10, characterized in that at least one bearing surface for a printed circuit board and a mounting element which latches to the printed circuit board and presses the printed circuit board against the bearing surface are provided.

35. Power supply unit for a system according to one of Claims 1 to 10, characterized in that a DEAD-OFF module is provided which terminates the life of the power supply unit if overheating by a predefined limiting value occurs.

36. Power supply unit for a system according to one of Claims 1 to 10, characterized in that it is vacuum sealed and suitable for external use.

37. Solar module for a system according to one of Claims 1 to 10, characterized in that a buffer battery and a voltage monitor are provided.

38. Control module for a system according to one of Claims 1 to 10, characterized in that the lighting system is automatically switched on or off when predefinable peripheral conditions occur, for example times or brightness levels.

39. Regulating module for a system according to one of Claims 1 to 10, characterized in that it is designed for the selective regulation of the power supply of individual printed circuit boards and/or individual LEDs on the printed circuit boards.

40. Sign, inscription, letter, in particular relief letter with illumination means, characterized in that the illumination is powered by means of a system or parts of a system according to one of Claims 1 to 39.

41. Use of a system of parts of a system according to one of Claims 1 to 39 for illuminating a sign, inscription or a letter, in particular a relief letter.

42. Lighting method, in particular for illuminating hollow elements such as signs, inscriptions, letters, in particular relief letters and the like, characterized in that a number of printed circuit boards provided with LEDs are connected to one another and/or to a voltage source by means of cables, and in that the printed circuit boards are

attached to a desired location by means of attachment elements.

Further details and advantages of the invention are to be found in the following description of a number of purely exemplary and nonrestrictive exemplary embodiments, in conjunction with the drawing, in which:

Fig. 1 shows a printed circuit board according to the invention with three LEDs in a plan view,
Fig. 2 shows the printed circuit board according to Fig. 1 in a side view,
Fig. 3 shows a printed circuit board according to the invention with six LEDs in a plan view,
Fig. 4 shows the printed circuit board according to Fig. 3 in a side view,
Fig. 5 shows a printed circuit board according to the invention with nine LEDs in a plan view,
Fig. 6 shows the printed circuit board according to Fig. 5 in a side view,
Fig. 7 shows an attachment element for attaching a printed circuit board in a plan view,
Fig. 8 shows the attachment element according to [lacuna].

Figures 1 to 6 show three different exemplary embodiments of the printed circuit boards 10, 30 and 50 according to the invention, which differ in the number of respectively provided LEDs and protective resistors and in the dimensions, but have the same basic design so that these three exemplary embodiments are described together in order to avoid repetitions.

Each printed circuit board is composed of a carrier element 12, 32, 52 made of non-conductive material on which conductor tracks 14, 16, 34, 36, 54, 56 for feeding in and discharging current for the LEDs which are respectively provided are provided in a manner known per se.

LEDs are also mounted on each printed circuit board using what is referred to as a chip-on-board technique, also termed the bonding method, while the LEDs are also referred to as LED chips owing to their design. To be precise, three LEDs 18 are mounted on the printed circuit board 10, six LEDs 38 and 40 on the printed circuit board 30 and nine LEDs 58, 60 and 62 on the printed circuit board 50. In each case, three LEDs are connected here in series, a protective resistor 24, 44, 46, 64, 66, 68 being connected into each series.

One mounting opening (in printed circuit board 10 and 30) or two mounting openings 17, 37, 57 (in the printed circuit board 50) are provided in each printed circuit board and the mounting element of an attachment element shown in Figures 7 and 8 can be guided through said openings 17, 37, 57. Each printed circuit board also has two guide grooves or cutouts 19, 39 and 59 which, when an appropriately formed plug is fitted over the ends of the conductor tracks which act as connecting points and which are not provided with a protective coating, guide said plug.

Provided in the vicinity of each connecting point in each printed circuit board is an opening 15, 35 or 55 which has the purpose of receiving a latching projection which is

provided on a corresponding plug so that a plug which is fitted on is advantageously secured against slipping down.

Sub a7

In Figures 7 and 8, an attachment element, designated in its entirety by 90, for a printed circuit board is shown, in which attachment element two supporting plungers 94 which each form a bearing surface for a printed circuit board on a supporting plate 92 and a mounting element 96 which latches to the printed circuit board and presses the printed circuit board against the bearing surface are provided. Latching projections 100 corresponding to the latching element are formed on the latching element which is divided in two here. An adhesive strip 98, by means of which the mounting element can be particularly easily attached, for example in a relief letter, is provided under the supporting plate 92.

Figures 9 to 11 show the inside of the housing rear wall of three different relief letters with different heights, onto which printed circuit boards are adhesively bonded in a manner according to the invention.

As is clear from Figures 1 to 6, the wiring of the LEDs is failsafe: if an LED in a group of three fails, the entire group of three is "dead", but this does not affect the other LED groups provided on the printed circuit board nor printed circuit boards connected in series with the affected printed circuit board.